Pearson Edexcel Level 3 Certificate

Mathematics in Context

Paper 1: Comprehension

Wednesday 16 May 2018 – Morning
Source booklet

Paper Reference
7MC0/01

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Formulae sheet

There will be no credit for anything you write on this formulae sheet.

Mean of a frequency distribution $= \dfrac{\sum fx}{\sum f}$

Mean of a grouped frequency distribution $= \dfrac{\sum fx}{\sum f}$, where x is the mid-interval value

Variance $= \dfrac{\sum (x - \bar{x})^2}{n}$

Standard deviation (set of numbers) $\sqrt{\left[\dfrac{\sum x^2}{n} - \left(\dfrac{\sum x}{n}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum (x - \bar{x})^2}{n}\right]}$

where $\bar{x}$ is the mean of the set of values

Standard deviation
(discrete frequency distribution) $\sqrt{\left[\dfrac{\sum fx^2}{\sum f} - \left(\dfrac{\sum fx}{\sum f}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum f(x - \bar{x})^2}{\sum f}\right]}$

Spearman's rank correlation coefficient $1 - \dfrac{6\sum d^2}{n(n^2 - 1)}$

The product moment correlation coefficient is

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{\sum x_i y_i - \frac{\left(\sum x_i\right)\left(\sum y_i\right)}{n}}{\sqrt{\left(\sum x_i^2 - \frac{\left(\sum x_i\right)^2}{n}\right)\left(\sum y_i^2 - \frac{\left(\sum y_i\right)^2}{n}\right)}}$$

The regression coefficient of y on x is $b = \frac{S_{xy}}{S_{xx}}$

Least squares regression line of y on x is $y = a + bx$ where $a = \bar{y} - b\bar{x}$

Arithmetic series

$$u_n = a + (n - 1)d$$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n[2a + (n - 1)d]$$

Geometric series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

$$S_\infty = \frac{a}{1 - r} \text{ for } |r| < 1$$

There will be no credit for anything you write in this source booklet.

SECTION A: OBESITY

Data source A

The UK Office for National Statistics' 2012-based National Population Projections suggest that the average (median) age of the population would rise from 39.7 in 2012 to 42.8 in 2037 if current demographic trends continued. More recent estimates for mid-2014 suggest the median age of the UK population was at its highest ever at 40 years.

Population pyramid for the United Kingdom as at the 2011 census

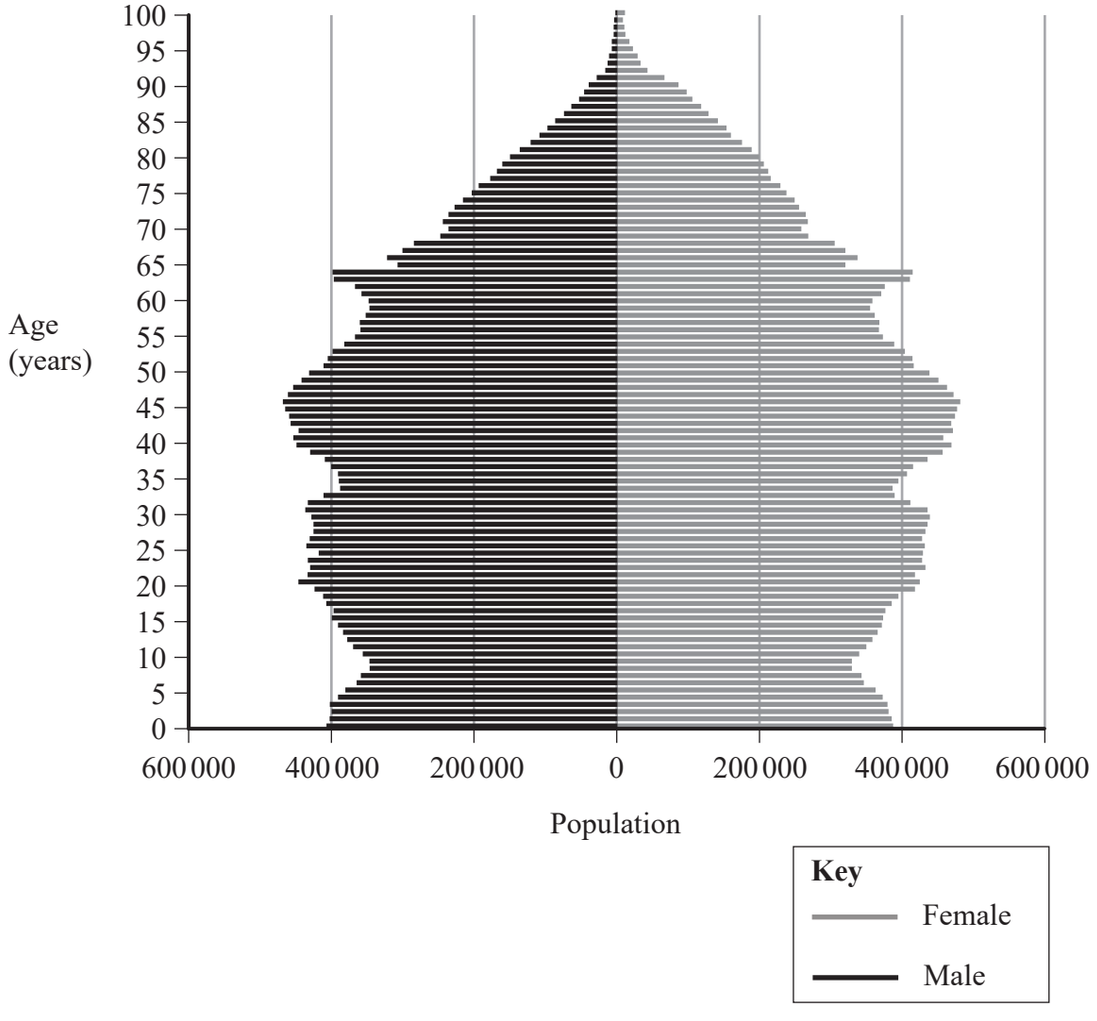

Table 1: Age structure for UK population as at the 2011 census

Age (years)	Population	% of total
0 – 4	3 914 000	6.2
5 – 9	3 517 000	5.6
10 – 14	3 670 000	5.8
15 – 19	3 997 000	6.3
20 – 24	4 297 000	6.8
25 – 29	4 307 000	6.8
30 – 34	4 126 000	6.5
35 – 39	4 194 000	6.6
40 – 44	4 626 000	7.3
45 – 49	4 643 000	7.3
50 – 54	4 095 000	6.5
55 – 59	3 614 000	5.7
60 – 64	3 807 000	6.0
65 – 69	3 017 000	4.8
70 – 74	2 463 000	3.9
75 – 79	2 006 000	3.2
80 – 84	1 496 000	2.4
85 – 89	918 000	1.5
90+	476 000	0.8

Data source B

UK among worst in western Europe for level of overweight and obese people

Only Iceland and Malta have higher proportion of people who are overweight or obese, study finds.

The Global Burden of Disease study, published in the Lancet medical journal, which uses data from 1980 to 2013, found that the number of overweight and obese people in the world had surged in the past three decades. About 2.1 billion people – nearly 30% of the population of the planet – are overweight or obese, raising the risk of diabetes, heart disease and cancers. Although the rise in obesity rates seems to be slowing in some countries, it has yet to be reversed in any.

"Obesity is an issue affecting people of all ages and incomes, everywhere," said Dr Christopher Murray, director of the Institute of Health Metrics and Evaluation (IHME) in Seattle and a co-founder of the Global Burden of Disease study.

"In the last three decades, not one country has achieved success in reducing obesity rates, and we expect obesity to rise steadily as incomes rise in low- and middle-income countries in particular, unless urgent steps are taken to address this public health crisis."

In western Europe, the UK lags behind only Iceland, with 74% of men and 61% of women overweight or obese, and Malta, with 74% and 58% respectively.

Table 2a: Top 5 countries for overweight or obese men, aged 20+

Country	Men (%)
Malta	74.0
Iceland	73.6
Greece	71.4
Cyprus	67.8
UK	66.6

Table 2b: Top 5 countries for overweight or obese women, aged 20+

Country	Women (%)
Malta	57.8
Iceland	60.9
UK	57.2
Portugal	54.6
Israel	52.7

Obesity alone increased by 10% in the UK over the past three decades, the study finds. There was a slight drop in the numbers of obese people between 1980 and 1986, before it began to rise steadily. About a quarter of the UK population is now obese. The peak age for children is at 5–9, when about 10% are obese. Among adults, it is at 60–64, when a third of men and women are obese. "Despite the significant advancements that the United Kingdom has made in public health over the last 30 years, we have not been immune to this global trend," said Dr Ivy Shiue, assistant professor at Heriot-Watt University, Edinburgh, and an author of the study. "The rapid increase in child obesity is particularly disturbing, as being overweight at a young age can set children up for a lifetime of poor health."

Data source C

In this article it shows you how to calculate your BMI and how to find your weight category. BMI is a measurement which determines which weight category a person belongs to. Depending on their height and weight, a person can belong to one of the following weight categories:

- underweight (BMI less than 18.5)
- normal weight ($18.5 \leqslant \text{BMI} < 25.0$)
- overweight ($25.0 \leqslant \text{BMI} < 30.0$)
- obese (BMI 30.0 and above)

$$\text{BMI} = \frac{(\text{weight in kilograms})}{(\text{height in metres})^2}$$

Data source D

Obesity and GDP: Do people in richer countries just eat more?

Statistics Canada Daily has just reported on an article on the prevalence of adult obesity in Canada and the United States. In the United States, the National Health and Nutrition Examination Survey (NHANES) has been gathering measured height and weight data for years. In 2007, the Canadian Health Measures Survey (CHMS) began collecting direct measurements of height, weight, body mass index (BMI), skinfolds and waist circumference from a nationally representative sample of the population. The nature of these surveys has created an opportunity to compare rates of obesity among adults in Canada and the United States. The results show that from 2007 to 2009, the prevalence of obesity (defined as a BMI of 30 or greater) in Canada was 24.1%, over 10 percentage points lower than in the United States (34.4%). Among men, the prevalence of obesity was over 8 percentage points lower in Canada than in the United States (24.3% compared with 32.6%) and among women, more than 12 percentage points lower (23.9% compared with 36.2%).

The interesting question is what may account for the difference? Is it lifestyle? Cultural preferences? Given the similarities between Canada and the United States, it is difficult to see what major cultural or lifestyle differences could account for such a difference. One major difference between the two countries is economic – the difference in GDP per capita. It could be differences in the material standard of living, as captured by GDP, affect the resources available for food consumption. Moreover, income and education are also correlated and it could be that countries with higher incomes have better educated populations and therefore are more knowledgeable about health and food consumption, meaning the relationship between BMI and income could be negative rather than positive.

The GDP (Gross Domestic Product) for each country is the total value, in dollars, of all the transactions (goods and services) in one year.

The GDP per capita is the GDP for that country divided by the population of that country.

Table 3: GDP per capita (US $) and the percentage of population with BMI $\geqslant$ 30

Country	GDP per capita (US $)	Percentage of population with BMI $\geqslant$ 30
United States	45 674	27.5
Greece	29 268	18.1
Estonia	19 880	18.0
Czech Republic	25 530	17.1
Canada	37 808	15.9
Finland	35 237	15.7
Turkey	14 243	15.2
Belgium	36 308	13.8
Israel	27 661	13.6
France	33 698	11.2
Netherlands	40 813	11.1
Norway	55 750	10.0
Sweden	36 996	10.0
Italy	32 408	9.9

SECTION B: FORMULA 1 RACING

Data source E

October 2015

After the ecstatic Lewis Hamilton took the chequered flag on Sunday he performed donut spins for the cheering crowd while Daft Punk's "One More Time" blared out from the Mercedes garage. As he crossed the line and had it confirmed that he had equalled his idol Ayrton Senna with his third F1 world title, the 30-year-old said over the car radio: "This is the greatest moment of my life."

A little later tears mixed with sprayed champagne. Beside Hamilton and his beaten team-mate Nico Rosberg and Ferrari's Sebastian Vettel on the podium there was Sir Elton John. It is not often that he looks upstaged.

Hamilton needed to beat his closest challenger, Vettel, by nine points and Mercedes team-mate Rosberg by two, and he did just that – finishing the race 76 points clear of his nearest rival, with 75 points still available. Rosberg was second and Vettel, who needed to be runner-up if Hamilton won to push the championship into next weekend's race in Mexico, was third.

Even as he approached the winning line Hamilton could not be certain he had won the championship because Vettel continued to put Rosberg under intense pressure until the end. It was Hamilton's third win in the four races in Austin as he secured the title.

The rain which had blighted much of the weekend in Texas finally relented. But its legacy was a damp and occasionally wet track which made this the busiest, most unpredictable of races. The rain had forced the cancellation of qualifying on Saturday and curtailed it on Sunday morning, with grid positions decided by Q2 (second qualification session). All the cars started on intermediate tyres.

The only predictable thing was the start. Hamilton, who was second on the grid, went straight on the attack and was level with the pole-sitter Rosberg almost immediately. Then, as they went into turn one, Hamilton, on the inside, squeezed his team-mate wide. Rosberg would not yield and the two touched wheels but it was Hamilton's racing line and the German was forced out, dropping to fourth behind Kvyat and Daniel Ricciardo.

It was yet another example of Rosberg's inability to beat Hamilton in wheel-to-wheel racing. He knew he could not afford to finish second to Hamilton in this race but he could not do anything about it.

Vettel, who had started back in 14th place because of a 10-place grid penalty, refused to let himself drift out of the championship picture and steadily worked his way through the field.

The Englishman's 10th win of the season put him alongside Sir Jackie Stewart with three titles but he is the first British driver to successfully defend his championship.

Table 4: 2015 Australian Grand Prix qualifying times

		Fastest lap time (minutes and seconds)		
Driver	**Team**	**Q1**	**Q2**	**Q3**
Lewis Hamilton	Mercedes	1:28.586	1:26.894	1:26.327
Nico Rosberg	Mercedes	1:28.906	1:27.097	1:26.921
Felipe Massa	Williams	1:29.246	1:27.895	1:27.718
Sebastian Vettel	Ferrari	1:29.307	1:27.742	1:27.757
Kimi Räikkönen	Ferrari	1:29.754	1:27.807	1:27.790
Valtteri Bottas	Williams	1:29.641	1:27.796	1:28.087
Daniel Ricciardo	Red Bull Racing	1:29.788	1:28.679	1:28.329
Carlos Sainz	Toro Rosso	1:29.597	1:28.601	1:28.510
Romain Grosjean	Lotus	1:29.537	1:28.589	1:28.560
Pastor Maldonado	Lotus	1:29.847	1:28.726	1:29.480
Felipe Nasr	Sauber	1:30.430	1:28.800	
Max Verstappen	Toro Rosso	1:29.248	1:28.868	
Daniil Kvyat	Red Bull Racing	1:30.402	1:29.070	
Nico Hulkenberg	Force India	1:29.651	1:29.208	
Sergio Perez	Force India	1:29.990	1:29.209	

Key **Q1** First qualifying session
Q2 Second qualifying session
Q3 Third qualifying session

In the Formula 1 World Championship, drivers take part in a number of Grand Prix races. The first ten drivers in each race get points depending on their end of race position. Their points from each race are added up. The driver with the most points at the end of the season wins the World Championship.

Table 5: Grand Prix championship points awarded for end of race position

Race position	Championship points
1	25
2	18
3	15
4	12
5	10
6	8
7	6
8	4
9	2
10	1

Table 6: Grand Prix circuit lap length and fastest lap times for 2014 and 2015 seasons for 18 countries

Country	Lap length (km)	Fastest lap time (minutes and seconds) 2014	Fastest lap time (minutes and seconds) 2015
Australia	5.303	1:32.478	1:30.945
Malaysia	5.543	1:43.066	1:42.062
China	5.451	1:40.402	1:42.208
Bahrain	5.412	1:37.020	1:36.311
Spain	4.655	1:28.918	1:28.270
Monaco	3.337	1:18.479	1:18.063
Canada	4.361	1:18.504	1:16.987
Austria	4.326	1:12.142	1:11.235
Great Britain	5.891	1:37.176	1:37.093
Hungary	4.381	1:25.724	1:24.821
Belgium	7.004	1:50.511	1:52.416
Italy	5.793	1:28.004	1:26.672
Singapore	5.065	1:50.417	1:50.041
Japan	5.807	1:51.600	1:36.145
Russia	5.872	1:40.896	1:40.071
United States	5.470	1:41.379	1:40.666
Brazil	4.309	1:13.555	1:14.832
Abu Dhabi	5.554	1:44.496	1:44.517

Source information

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